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ABSTRACT

This paper examines the research on how student-to-instructor ratio effects influence schooling, with particular attention to how the research relates to low-achieving children. It also summarizes the conclusions of several existing reviews of literature on: the effects on schooling outcomes of class or instructional group size; and scheduled, instructional, or engagement time. Findings include the following: (1) Reduced class size appeared to be most efficacious with low-ability or disadvantaged students when reductions were in the range typically associated with programs administered under Chapter 1 of the Education Consolidation and Improvement Act of 1981. (2) Such reductions can lead to better student and teacher attitudes and morale and to an enrichment of the core curriculum. (3) Increases in allocated, instructional, and engaged time lead to increases in learning. (4) Allocated time shows a lesser relation to achievement than more proximal time measures. (5) The greater amount of allocated time given to Chapter 1 students may serve to lessen an advantage that more able students possess because they generally spend more time engaged in appropriate tasks. (6) Reductions in class size and increases in time can only produce positive effects if the following also is true: teachers are adaptable and have the skills and motivation to capitalize on these instructions; the material taught and tested fits together; and the strategy for accomplishing the reduced student-instructor ratio creates fewer barriers to learning than it breaks down. A list of reference is appended. (PS)

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CHAPTER 1 PROGRAMS REDUCE STUDENT-TO-INSTRUCTOR RATIOS BUT DO REDUCED RATIOS AFFECT ACHIEVEMENT?

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CHAPTER 1 PROGRAMS REDUCE STUDENT-TO-INSTRUCTOR RATIOS BUT DO REDUCED RATIOS AFFECT ACHIEVEMENT?

The Sustaining Effects Study of Title I programs (see Carter, 1984) included a description of the practices and services that constitute compensatory education. Based on extensive interviews and visits to 55 poverty-area schools, the report noted several major differences between the services received by compensatory education students and regular students. Among these differences was that Title I pupils received more hours of instruction in reading and math. In addition, Title I students more often received this instruction in smaller classrooms and/or in smaller instructional group settings.

The Title I Demonstration Study documented a similar impact on instructional settings (Archambault & St. Pierre, 1979). This study collected data from 12 school districts and compared the services received by Title I students and their non-Title I counterparts. The Demonstration Study found that, when compared to non-Title I students in either their own or other schools, Title I students spent about 13 minutes more a day in language arts instruction. About one-fourth of the Title I students' instruction occurred in a compensatory setting.

The Demonstration Study also documented differences in the size of instructional groups. The large majority of regular language arts instruction occurred in groups of 6 or more with about one-third of all regular instruction occurring in groups of 6 to 20 students. However, in 9 of the 12 districts more than 50 percent of the Title I students' compensatory instruction was at the individual level or in groups of 2 to 5 students. The percentage of compensatory instruction delivered in groups of 5 pupils or less ranged from 37 percent to 100 percent across the districts.

In sum, then, two effects of Title I programs, and the Chapter 1 programs that followed, are that children needing compensatory education get more instruction in basic skills areas and this added instruction usually occurs in small groups. Both effects can be viewed as products of the decreased student-to-instructor ratio that occurs because Chapter 1 programs allow the hiring of additional specialists, classroom teachers, and/or instructional aides.

The purpose of this paper is to examine the research on how student-to-instructor ratio effects influence schooling, with particular attention to how the research relates to low-achieving children. Two areas of research are particularly germane. These involve the effects on schooling outcomes of

(a) class or instructional group size and (b) scheduled, instructional, or engagement time. Because both areas have generated considerable interest within the educational community, numerous previous attempts to synthesize these research literatures already exist. Therefore, rather than attempt another synthesis, this paper will review the conclusions of several existing reviews of the literatures.

Class and Instructional Group Size

Class Size and Achievement

The first empirical study of the effects of class size on achievement was conducted by Rice before the turn of this century (Rice, 1902). Between 1900 and 1975, at least 76 more studies were conducted. Interest in class size was strong during the period 1910 to 1930, diminished from 1930 to 1960, and reemerged as an important topic during the past 25 years.

Since 1968, at least 20 reviews of the class size literature have been published. One of these reviews, by Gene Glass and Mary Lee Smith (1978), received considerable attention from both the educational research community and the general public. The conclusions of this review and some of the surrounding debate provide a good context for examining the underlying research literature and the issues raised by it.

Glass and Smith performed a meta-analysis on the outcomes of 77 studies that included 725 comparisons between a smaller and larger class on a measure of achievement. Half of the comparisons involved elementary school children and all types of subject matter were included. The size of smaller and larger classes varied from comparison to comparison, with a particular class size being the small class in some studies and the large class in others. For instance, in one study a "class" of one student was compared with a "class" of two students. In 197 comparisons, class sizes between 24 and 34 were compared to classes with 35 or more students.

Glass and Smith found that 60 percent of all comparisons favored the smaller class. When classrooms with about 18 students were compared to classrooms containing about 28 students, the percent of comparisons favoring the smaller class rose to 69 percent. Ninety-eight percent of comparisons (45 of 46) between class sizes of 2 and 28 pupils favored the smaller class. In contrast, when smaller classes contained 30 students or more no advantage was found over classes larger in size.

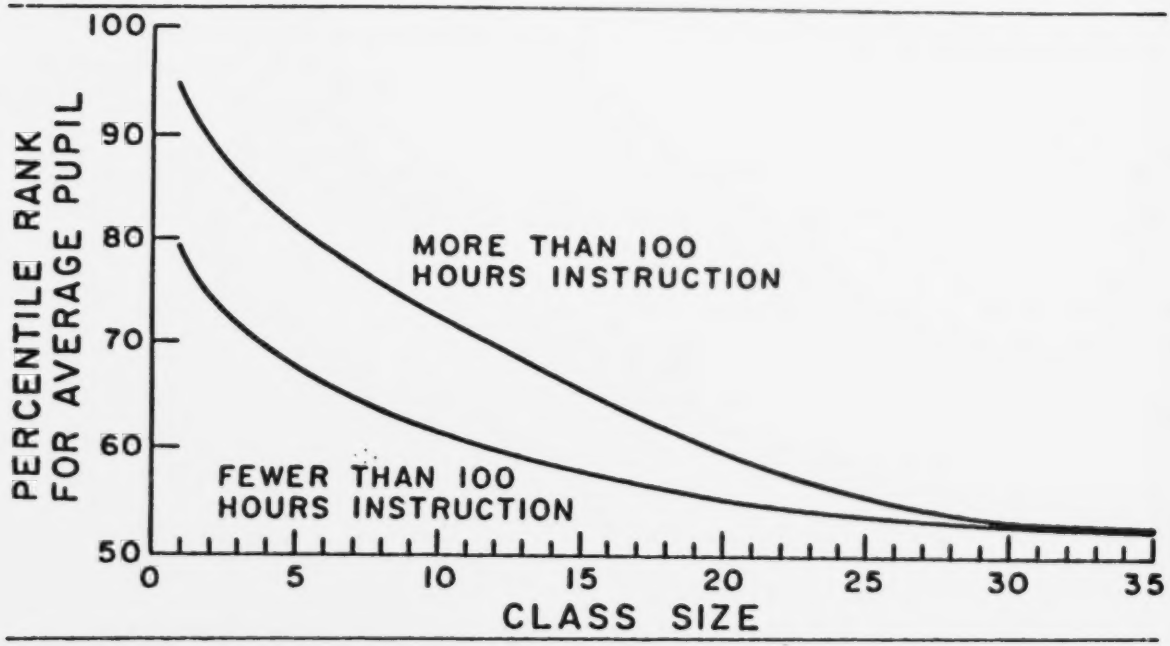
The meta-analysis paid special attention to the 109 comparisons from studies that employed random assignment of

pupils to the smaller and larger classes. Figure III-5 presents the mathematical relationship between class size and percentile achievement ranking of the average pupils in the class based on these experimental studies. The graph is set so that the rank for the average student in a class of 40 is at the 50th percentile. It should first be noted that the effect of class size appeared to grow as size was reduced, meaning a reduction from, say 10 to 5 students had a greater impact than a reduction from 30 to 25 students. Additionally, two curves are presented, one for comparisons of class size after more than 100 hours of instruction and one for studies of shorter duration. As the graph indicates, the meta-analysis found that studies covering longer periods of instruction found results more strongly favoring smaller classes. Two illustrations will demonstrate how the curves can be applied. First, the graph indicates that a student whose achievement surpassed 50 percent of his classmates in a class of 40 students would exceed 60 percent of these classmates if he were taught in a class of 20 students for over 100 hours. In contrast, this student would surpass 55 percent or 56 percent of students in classes of 40 if given less than 100 hours of instruction in a class of 20 pupils.

Glass and Smith noted that the curves generated by carefully controlled studies were steeper than those from less well-controlled studies. Perhaps most crucial to this discussion, the meta-analysis indicated that the relation between class size and achievement did not change significantly for students of different ages or different ability levels.

The attention given Glass and Smith's meta-analysis was due to the clarity of its findings. Whereas past reviews had labeled the literature inconsistent and inconclusive, this review found clear evidence that reduced class size produced increased academic achievement. As the journal Phi Delta Kappan (Staff, 1979) stated: "The Glass study is the first by a nationally recognized researcher to make unequivocal statements about the effects of class size on pupil achievement. It has enormous policy implications" (p. 411). However, the meta-analysis did not go uncriticized. Most prominent among these were (a) a reanalysis of the data by Hedges and Stock (1983), (b) two articles by Slavin (1984a, 1984b) appearing in the Educational Researcher, and (c) a monograph published by the Educational Research Service (1980).

Hedges and Stock (1983) noted that there were at least two problems with the estimation procedures employed by Glass and Smith. First, the effect size estimate used in the meta-analysis tended to overestimate the population effect size. Second, the variance of a study's effect size estimate should be based on its sample size and the Glass and Smith meta-analysis did not take this into account. Hedges and Stock



Source: Glass, G. V., Cahen, L. S., Smith, M. L., & Filby, N. N. (1982). School class size. Beverly Hills, CA: Sage.

Figure III-5. The Relationship of Class Size and Pupil Achievement Based on 109 Experimental Comparisons in the Research Literature

reanalyzed the data using more appropriate model assumptions. They concluded that the new effect size curves would lead one toexpect lower achievement in smaller classes than the original curves. However, smaller classes still led to higher expected achievement than larger classes and the shape of the curve remained unchanged. Also, the authors stated that, "the tests of significance confirm that class size accounts for a substantial amount of achievement variation, while also indicating that substantial sources of systematic variation remain to be explained" (pp. 83-84).

Slavin's (1984a) critique dealt primarily with the fact that Glass and Smith's effects were strongly influenced by studies of tutoring, not class size. Specifically, Slavin contended that if studies comparing a class composed of one student with a larger class were removed from the meta-analysis only a trivial effect of class size would remain. The description of how the achievement of an average child in a class of 40 would be affected by instruction in a class of 20 was an extrapolation based on studies of tutoring (Slavin, 1984b). Slavin summed up by saying that "there is nothing in the Glass et al. meta-analysis to contradict an assertion that class size makes no difference in achievement unless the smaller class has no more than three students" (p. 11).

Glass, Cahen, Smith, and Filby (1982) responded to this criticism by referring to an unreported analysis that calculated the curves eliminating all comparisons in which the smaller class size was less than 5 students. This analysis found the general shape and elevation of the curve to be similar to that in Figure III-5. Carlberg and Associates (1984) also defended the class size meta-analysis by taking the position that it is, in fact, legitimate to conceptualize the tutoring situation as a class size of one. Further, they claimed that Slavin's concern about extrapolating the effect size curve beyond a class size of three rests on the assumption that an extraordinary discontinuity of effect would occur between class sizes of three and four. The authors had never seen such a discontinuity and doubted that one exists.

The Educational Research Service (ERS; 1980) highlighted five additional areas of criticism. These were that: (a) the meta-analysis obscured important distinctions in class size research; (b) the major findings were based on too few studies and were thus overgeneralized; (c) the interpretation of findings was often contradictory; (d) the conclusions unjustifiably encouraged class size reductions; and (e) the generalizations created doubt about the need for further research.

Glass and Associates (1982) responded to each criticism, but three rebuttals are most relevant here. The meta-analysts said that they carefully examined numerous distinctions in the

literature and found that, aside from hours of instruction, the differences were too small to justify separate conclusions. These distinctions included subject matter, I.Q. level, and grade level. In addition, they made no generalizations, certainly not to populations not included in the studies, but merely described their findings. Finally, the ERS assertion that too few studies were included was based on the decision to use only the carefully controlled studies to generate the curves, ERS ignored their discussion of the 77-study database in making the "too few studies" claim.

There is an important footnote to the ERS critique. Glass and Associates attempted to infer why ERS might have rejected their effort. They noted that ERS was established and supported by seven organizations representing school boards, administrators, and principals, or, according to the meta-analysts "the professional organizations in the United States who have historically been opposed to teachers' unions in negotiations over salary and working conditions" (p. 84). The implication was that the ERS interpretation was not independent of its sponsors' organizational relation to the class size issue. This relation dictated, at the least, a skeptical view on ERS' part of research finding benefit in small classes.

In light of its dismissal of the meta-analysis, it should be noted that ERS published its own review of the class size literature in the same year that the Glass and Smith effort appeared (ERS, 1978). Examining the findings of this review may help identify aspects of the class size and achievement relation about which there is some agreement.

The ERS review covered 24 studies involving grades K through 8, 14 studies at the high school level, and three general studies, all conducted since 1950. This review concluded that the research provided no clearcut guidelines for an optimum class size. At the same time, however, it was recognized that important decisions concerning class size could not await definitive research findings and that some assertions about class size effects were appropriate even if the existent research was less than adequate. In this spirit, ERS offered 19 "tentative [emphasis added] conclusions for consideration when school officials formulate educational policy" (p. 68). Among these conclusions were:

(a) the relation between pupil achievement and class size is highly complex;

(b) efficient class sizes are a product of many variables, including subject area, nature of the pupils, learning objectives, materials and facilities, and the skills and temperament of the teacher; and

(c) within the mid-range of 25 to 34 pupils, class size appears to have little if any decisive impact on the academic achievement of most pupils in most subjects above the primary grade. (p. 69)

This last finding qualified but was not necessarily inconsistent with that of Glass and Smith (1978). Most salutary from the present perspective was a set of three conclusions about the research evidence that indicated:

(a) Small classes are important to increased pupil achievement in reading and mathematics in early primary grades;

(b) pupils with lower academic ability tend to benefit from small classes more than do pupils of average ability; and

(c) smaller classes can positively affect the scholastic achievement of economically or socially disadvantaged pupils. (p. 69)

It may be possible, then, for those concerned with compensatory education to find some light amid the heat surrounding the interpretation of class size research. While they disagreed about the generality and robustness of the class size effect, both the meta-analysis and the ERS review concluded that smaller class sizes benefit the population of students served by Chapter 1 programs. Glass and Smith did so by finding the benefit of small classes held for students regardless of their intelligence level. ERS found the benefit for low-ability or economically disadvantaged children only. Further, the typical size of compensatory education instructional groups falls within the range about which there appears to be some agreement. It will be recalled that from one-third to all of Title I students in the districts sampled by the Demonstration Study received compensatory instruction in groups of one to five students. All the reviewers agreed that this is the end of the class size curve where effects are most dramatic and dependable.

Class Size and Nonachievement Variables

While a student's subject matter knowledge is certainly the primary concern of educators, achievement is only one aspect of children affected by the schooling process. Likewise, teachers are affected by their interactions with students. Attention needs to be paid, therefore, to the nonachievement effects of alterations in class size.

It should not be surprising to find that when Smith and Glass (1980) meta-analyzed the research on nonachievement correlates of class size they discovered the strongest relations involved teacher variables. Measures of effects on teachers included morale, absences, attitude toward students, expectations for performance, perceptions of satisfaction and workload, and professional growth. Of 30 comparisons between smaller and larger classes involving teacher variables, 25 favored the smaller classroom (Glass et al., 1982). The meta-analysts concluded that teacher morale and liking of pupils is higher and satisfaction with performance is greater in smaller classes.

The Class Size and Instruction Program conducted by Leonard Cahen and associates (1983), to be addressed in detail shortly, suggested reasons why class size has such a great impact on teachers. These authors noted that teachers face an enormous management task in monitoring and instructing a class of students. The reduction in class size, therefore, may have a pronounced impact on a teacher's cognitive load, and may make the effect of the reduction appear greater to the teacher than that which actually occurs. In fact, a 1973 Gallup Poll indicated that 85 percent of professional educators thought small classes "make a great deal of difference" in the achievement or progress of students (Elam, 1973).

The Smith and Glass meta-analysis also found positive effects of reduced class size on student variables. One group of effects, labeled "student attitudes," included measures of attitudes toward the teacher and school, self-concept, mental health, and motivation, among others. This category of effects demonstrated a difference of 29 percentile ranks between students in classes of size 40 and size 10. Another group of effects involving measures of student participation showed a difference between classes of 10 and 40 students equal to 23 percentile ranks. Finally, a group of variables measuring different types of student misbehaviors also favored smaller classes, but the number of comparisons was too small to estimate a percentile rank difference.

Class Size and Instruction

Studying the relation of class size to the outcomes of schooling is the first step in assessing the impact of student-to-instructor ratios on the educational process. However, it leaves unaddressed the equally important question of how changes in the number of students alter classroom life. Understanding how the process of schooling is affected by the size of the group in which it occurs help ensure that interventions will be implemented only in those circumstances most likely to produce the desired effects.

Smith and Glass' (1980) meta-analysis found that smaller class sizes were associated with greater individualization and informality, higher quality of instruction, and more positive school climate. However, only the individualization and quality of instruction categories contained sufficient comparisons to estimate the effect size in terms of percentile rank changes. Individualization included measures such as the teacher's knowledge of pupils, frequency of dyadic interactions, variety of activities, adaptation of teaching to individual students, and conferences with parents, among others. Quality of instruction included use of teaching aids, organization, task structuring, and number of varied and innovative activities, as well as more general quality assessments. Comparing classes of 10 students with classes of 40 students, the difference for individualization was 19 percentile ranks while for quality of instruction it was 17.

It is important to note that the meta-analysis effect sizes for all three nonacademic outcomes--teacher and student effects and classroom instruction--are expressed as a comparison of a large class, 40 students, that is not representative of the average size of present-day classrooms and a small class, 10 students, that is probably an unrealistic expectation for the reduced size of regular classes. Thus, the effects may be larger than those that could be reasonably obtained in practice. Also, the nonacademic effects of class size interacted with the age of the student. The impact of reducing class size was greatest for students under age 12, somewhat less for students 13 to 17, and least for students 18 and over.

While the meta-analysis gives an overview of the literature as a whole, examining the details of an exemplary study can provide additional insight and contextualization. The Class Size and Instruction Program (CSIP; Cahen et al., 1983) provided an in-depth examination of what happens in classrooms when class size is reduced. The CSIP study involved the intensive examination of four second-grade classes, drawn from one inner-city school in California and one rural school in Virginia. In both schools, class size was reduced by one-third in January by reassigning some students to a new class. In California, class size was reduced from 35 to 22 and in Virginia from 20 to 13. The research team used both quantitative and qualitative methods for collecting data, including coded observations, tests, discussions with teachers and students, and examination of student work, teacher journals and lesson plans, and school-wide documents.

Although specific changes sometimes varied, the CSIP study found certain consistencies across classes. The changes could be grouped into three categories: behavior management, individualization, and curriculum.

Teachers in the study felt that the smaller classes made discipline easier and that they spent more time teaching and less time policing. This perception was borne out by observational data indicating students paid closer attention when class size was reduced. Attention was enhanced in group discussions because fewer students were lost in the crowd and all students had more frequent opportunities to participate. The researchers speculated that the effect on participation might be most pronounced for low achievers because "in a small group, where control is perceived to be easier, the teacher may feel she or he can take time to draw all students into the lesson" rather than "rely on volunteers or high ability students in order to keep things moving along" (p. 202). During seatwork, attention is enhanced because the amount of contact time between teachers and students increases. This is simply a matter of the teacher having fewer students among whom to divide a constant period of time.

The behavior management results of the CSIP study are paralleled by results from the Sustaining Effects Study (Carter, 1984). This study found that the smaller instructional groups and lower student-instructor ratio associated with Title I programs was associated with more student on-task behavior, less teacher time in behavioral management, a more harmonious class environment, and a higher quality of cognitive monitoring, task monitoring, and organization of activities.

Teachers in the CSIP study also viewed the smaller classes as allowing greater opportunity to meet individual student needs. However, the smaller classes did not lead to dramatic individualization of instruction or curriculum. Group instruction continued and the curriculum was the same. Instead, teachers were able to provide students with more feedback, help, encouragement, and to find out more about individual feelings and interests.

While the curriculum was primarily determined by textbooks and remained unchanged by class size, teachers were able to cover it more effectively. Lessons ran more smoothly. Sometimes material was covered more rapidly and other times teachers expanded lessons by covering material in greater depth. The researchers noted that many of the enhancements to curriculum that occurred when class size was reduced might not immediately alter student achievement on tests. These enhancements were intended to promote positive attitudes, enthusiasm, and overall learning skills rather than narrowly defined subject domains.

The finding that smaller instructional groups often do not result in increased time spent on core material leads nicely into a discussion of the second effect of reduced student-to-

instructor ratios, namely, increased allocation of time to basic skills instruction.

Allocated, Instructional, and Engagement Time

As noted previously, research indicates Title I students spend about 13 minutes more a day in language arts instruction than non-Title I students (Archambault & St. Pierre, 1979) and similar, if not greater differences exist in math and reading (Carter, 1984). Numerous models of learning, most notably those of Carroll (1963) and Bloom (1976), have suggested that the amount of time spent on learning is an important determinant of how much is learned. We might expect, therefore, that the added instruction provided in Chapter 1 programs would lead to enhanced achievement.

However, the relation between time and learning is not quite that linear and invariate. First, at least three distinctions must be made in how time is measured. Scheduled or allocated time is the time set aside by law, school, and/or teacher for a particular learning activity to take place. Instructional time is the actual amount of time spent on academic material within the allocated time period. Instructional time will be less than allocated time to the extent that allocated time is spent on classroom management and interruptions. Engaged time, or time-on-task, is the time that students spend actually attending to lesson material. Based on classroom observations, a student's engaged time can range from about 40 percent to 85 percent of allocated time (e.g., Karweit & Slavin, 1981).

A first caution, then, in drawing implications from the increased time allocated to instruction in basic skills for Chapter 1 students is that allocated time does not translate directly into time-on-task. Some of the allocation advantage is lost because Chapter 1 students are more often absent from school than their non-Chapter 1 counterparts (Wang et al., 1978). Thus, for each student the instructional time advantage is less than the allocated time advantage. Also, research indicates that students of higher ability are on-task a larger percent of the time. Evertson (1980) found that low-achieving junior high school students were engaged in academic activities about 40 percent of the time while high achievers were engaged about 85 percent of the time. Werner and Simpson (1974) found the difference to be 66 percent to 88 percent, respectively. This finding implies that the added instructional time Chapter 1 students receive may be considerably greater than the addition to their time actually attending to academic tasks. Finally, because the total amount of time available in a school day is usually equal for all students, the added time Chapter 1

students spend learning basic skills typically means they spend less time involved with other curricular material.

There are some positive points to be made as well. Several studies, including the Class Size and Instruction Program (Cahen et al., 1983), have found that the smaller groupings in which Chapter 1 students receive instruction may facilitate task engagement. This synergism between both student-to-instructor ratio effects should help mitigate the relation between ability and engaged time. Perhaps more important, even if much of the difference between time allocated to Chapter 1 and non-Chapter 1 students is eroded by student differences in attendance and engagement, the added time is still compensatory. That is, the extra time may diminish a difference in time-on-task that favors the more able students. The important comparison, then, may not be between students eligible and not eligible for compensatory instruction but between how much time eligible students are engaged in basic skills tasks with and without compensatory instruction.

Assuming that compensatory instruction increases the Chapter 1 pupils allocated, instructional, and engaged time, then it becomes relevant to examine the research relating time to achievement.

Time and Achievement

The most often cited study of time and achievement is the Beginning Teacher Evaluation Study (BTES; Denham & Lieberman, 1980). This study targeted for examination 261 second and fifth graders in 46 classrooms. Borg (1980) called the BTES the "most detailed and comprehensive information ever collected on the relationship between allocated time and achievement" (p. 49). Data for this study were collected through classroom observation and teacher logs, rather than from school records and teacher recall, as had been the case in previous research. Tests of achievement were designed for the BTES and were divided into subtasks of reading and mathematics. Most analyses were replicated during two separate periods of the school year.

Using multiple regression to predict the residual variance in posttest achievement after controlling for pretest scores, Borg (1980) found that allocated time explained a significant ($p<.10$) amount of variance for 11 of 29 achievement measures. The percent of variance explained, however, was generally small, mostly accounting for 3 to 6 percent of the pretest/posttest difference. Similar regressions using engagement time as the predictor proved significant in 13 of 29 cases, explaining from 3 to 26 percent of the variance.

In a composite analysis, regressions were run on measures of achievement using four indicators of academic learning time, all entered into the equation simultaneously. The indicators were: allocated time, percent of time engaged, percent of low difficulty activities, and percent of high difficulty activities. Nine of a possible 58 tests of the allocated and engaged time measures proved to be significant predictors of achievement. About three significant effects would have been expected by chance. It should also be kept in mind that the simultaneous entry of the variables in these analyses meant that any correlation between the predictors diminished the estimate of each predictor's unique effect.

The conclusion of the BTES was that time allocated to instruction in a content area increases learning in the area and that the proportion of allocated time that students are attending further predicts learning.

Several other studies of time and learning have been conducted and, as with class size, this literature has been subjected to numerous syntheses. In fact, at least 10 syntheses of the literature have appeared since 1980, with several prompted by proposals to lengthen the school day or year. Two of these reviews will be summarized here. The first, by Wayne Fredrick and Herbert Walberg (1980), appeared in the Journal of Educational Research and was summarized in the Encyclopedia of Educational Research (Walberg & Fredrick, 1983). The second, by Nancy Karweit (1983), appeared as a technical report from the Center for the Social Organization of Schools and was summarized in the Educational Researcher (Karweit, 1985).

Fredrick and Walberg (1980) classified studies according to the unit of time measured: years of schooling, days in the school year, hours in the school day, and minutes of instruction. Only the studies of instructional time will be reviewed here.

Nine studies of instructional time and achievement were reviewed and the authors found that all nine showed a positive relation. They reported that the "correlations ranged from .15 to .53, but when other relevant variables were partialled out (I.Q., ability, readiness) they ranged from .09 to .44" (p. 190).

Although Fredrick and Walberg used the term "instructional time" to describe the studies they reviewed, a majority of the studies actually examined time-on-task. The authors noted that refining the measure to reflect actual time devoted to the outcome increased the magnitude of the correlation, but no specific data was given.

Finally, Fredrick and Walberg noted several studies that indicated the relation between time and learning reaches a plateau at which additional time has only a marginal impact on achievement. The exact nature of this curve was not estimated because the variations in time and achievement in previous studies had not been great enough to warrant such precision. Several reasons for the curvilinear relation were offered. These included: (a) achievement tests cannot detect high levels of gain; (b) progressively more pupils reach the ceiling of the skill and can improve no further; (c) instructional procedures may need to be changed as students become more skilled; and/or (d) the nature of learning itself may cause diminishing returns (Walberg & Fredrick, 1983).

Karweit (1983) began her synthesis by recasting some of the BTES results. First, she noted that partialing out the effect of pretest achievement on posttest achievement does not completely control for the relation between achievement and engagement. Therefore, the regression weight in the equation associated with engagement may be overestimated.

Karweit also pointed out that the effect of allocated time revealed in the BTES could be expressed as the number of additional minutes of instruction that would be necessary to increase the average student's achievement a certain amount. For instance, using the BTES regression equation for second-grade reading comprehension that included the four indices of academic learning time, Karweit found that it would take an additional 60 minutes per day to raise comprehension one-quarter of a standard deviation. A .25 standard deviation gain in total math achievement in grade 5 would require about 65 additional minutes of instruction per day. Based on these analyses, Karweit suggested that "dramatic changes (in allocated time) would be required to increase achievement by a quarter of a standard deviation" (p. 25).

Two important cautions need to be kept in mind when interpreting Karweit's analysis. First, her analysis assumed that the increase in allocated time would occur while the other three elements in the equation, percent of time engaged and percent of high- and low-difficulty activities, were held constant. Therefore, accompanying changes in these variables could reduce the amount of additional allocated time needed to produce the desired effect. Second, the added time necessary to have the desired effect was set to correspond to the length of the BTES observation period, which was about 70 days. Thus, the addition of about an hour of reading and math instruction per day would raise the average student's scores one-quarter standard deviation in about 14 weeks, or a third of a school year. The choice of a relatively short period for the effect to occur may make the daily increase in time needed to produce it appear large.

In addition to the BTES results, Karweit reviewed seven other studies, six of which examined engaged time or attention and learning. She reported a range for zero-order correlations between .25 and .58 and between .09 and .43 when initial achievement level was controlled for. These ranges are quite similar to those reported by Fredrick and Walberg (1980).

Karweit summarized her findings by stating that "very few negative effects of time-on-task on achievement are found" and "it would probably be helpful (and certainly not harmful) to encourage teachers to minimize time wasted and to try to increase student engagement" (p. 33). However, Karweit diverged from the conventional interpretation of this literature when she assessed the impact of time-on-task relative to other influences on classroom learning. She argued that "these findings point toward an explanation of classroom learning based more on accommodating student diversity in readiness for instruction and rate of learning and on quality of instruction than on the gross quantity of instruction delivered to or consumed by students" (p. 34). Simply adding time may not be a wise policy. A wiser policy, according to Karweit, would aim at more efficient use of time already available (also see Levin, 1984).

In sum, then, the literature on time and achievement indicates allocated, instructional, and engaged time all correlate positively with learning. The relation appears to grow stronger as the measurement of time moves from how much time is scheduled for learning to how much attention students pay to instruction. Also, the effect of additional time on learning appears to diminish as total time increases, but the underlying function curve is as yet unspecified. Finally, debate exists about whether the magnitude of the time effect, relative to other possible interventions, warrants the expenditure of resources needed to increase allocated time.

Time and Nonachievement Variables

The evidence is scant relating students' attitudes toward subject matter and the amount of time spent on them. Fredrick and Walberg (1980) located only two studies addressing this issue. In an observational study of sixth graders, Lahaderne (1968) found no significant relations between attitudes and time for various subjects. In a study of university students, McMillan (1977) found students who spent more time preparing an assignment had more positive attitudes toward it.

The area of time and attitudes deserves further attention, especially because of its role as a possible mediator of the time and achievement relation. However, correlational studies will be of little use in this area because it is highly

plausible that positive attitudes will lead students to spend more time on tasks. To assess the effect of time as the causal agent it will be necessary to experimentally manipulate the time variable.

Time and Instruction

Neither Fredrick and Walberg (1980) nor Karweit (1983) identified studies that examined the effects of allocated or instructional time on how curriculum material was presented. While there is some indication that students' time-on-task does not increase proportionately with increases in allocated time, we have no evidence concerning whether the proportions of instructional and management time change as allocated time changes. A study by Karweit and Slavin (1981) of time use in 12 classrooms would suggest little relation between the amount of allocated time and the proportion of that time spent in instruction or management. Again, however, this was a cross-sectional study and not a study of time change. It would be important to determine whether additional time is more often used to cover more curriculum material, to reinforce core material, or to present material that enriches the core curriculum.

Inhibitors of Reduced Student-to-Instructor Ratio Effects

The positive effects that reduced class size and increased time can have on the learning of basic skills certainly do not occur across all circumstances. Group size and time are just two elements among many that form the learning environment. Without exception, the primary investigators and major reviewers in these areas have identified or suggested other contextual factors that can diminish the benefits of reducing the student-to-instructor ratio.

Most discussion of moderators of class size and time effects have focused on the adaptability and skills of the teacher. The Class Size and Instruction Program study (Cahen et al., 1983) noted that teachers develop educational programs they are comfortable teaching and have been accepted at their schools. Changing the context in which the program occurs by reducing class size might not be enough in itself to induce a change in the program. Cahen and Associates concluded that teachers must desire a new program and must be willing to expend the personal time and effort needed to establish it. A similar willingness to adapt would seem essential for increases in allocated time to have their desired effect.

With regard to teaching skills, ERS (1978) noted that the teacher must know how to take advantage of the opportunity for greater individualization. Student learning will be the same whether the size of a class is 4 or 40 if the teacher is proficient only at lecturing. According to Noddings (1978) the individualization of learning can have negative effects if teachers inadequately monitor student progress so that students spend time practicing errors or failing to follow directions.

Finally, the overall quality of instruction can overwhelm the impact of any other contextual manipulation. ERS (1978) concluded that the class size research pointed to the importance of methods and quality of instruction rather than the raw number of students in class. Similarly, the World Bank (1978) conducted an overview of studies carried out in emerging nations and this review indicated that quality of instruction rather than the number of pupils in classes was the critical factor. Karweit (1983) makes the same precaution about the effects of allocated time.

Beyond teacher variables, an important moderator of group size and time effects may be the congruence between curriculum content and test materials. This point was highlighted by the Instructional Dimensions Study (Cooley & Leinhardt, 1978). The IDS modeled the processes occurring in 400 first- and third-grade classes in 100 schools serving disadvantaged students. The major findings revealed that individualization of objectives, pacing, diagnosis, and prescription were not a uniquely effective teaching strategy, other approaches worked equally well. The amount of instructional time was found to be an important determinant of achievement and this was especially the case when the instruction emphasized the particular skills measured on the achievement tests. Thus, a moderator of both class size and time effects was the amount of opportunity to learn the material contained on exams.

The Instructional Dimensions Study also reported that the extent of pullout instruction was not significantly related to achievement. Two other studies included findings indicating that, if class size reductions and additional instruction are accomplished through pullout, aspects of pullout situation itself may mitigate their positive effects. The Austin Independent School District (Doss & Holley, 1982) found school-wide reductions in class size had a greater positive effect on the achievement of Title I students than did pullout programs. A suggested reason for the relative ineffectiveness of the pullout programs was "the regular classroom teacher's decreased sense of responsibility for the special program students" (p. 1).

A study by the Rand Corporation on the aggregate effects of Federal education programs (Kimbrough & Hill, 1981) also

included some suggestions about why pullout methods might obviate the benefits of reduced student-to-instructor ratios. These authors found that in some school districts pullout programs (a) interrupted or replaced core instruction, (b) segregated minority students for large portions of the day, (c) imposed administrative burdens on teachers, (d) used methods and materials incompatible with those being used in regular classrooms, and (e) created conflict between staff members. Each of these influences might serve to diminish or negate the positive effects on learning that more time in small groups might have the Chapter 1 students.

Summation

Attempting to identify the effects of reduced student-to-instructor ratios on student achievement required the examination of two hotly debated topics in educational research. Reviewers of the class size literature disagreed over whether a reduction in instructional group size has its intended effect and, if the effect in fact exists, how general it is over other variations in the learning environment. However, some consensus did emerge with regard to the circumstances most relevant to this discussion. Reduced class size appeared to be most efficacious with low-ability or disadvantaged students when reductions were in the range typically associated with Chapter 1 programs. Such reductions may not only lead to higher achievement but to better student and teacher attitudes and morale and to an enrichment of the core curriculum.

There was less controversy over the research on time and learning. Scholars in this area generally agreed that increases in allocated, instructional, and engaged time lead to increases in learning. However, because allocated time does not translate directly into more time-on-task, allocated time shows a lesser relation to achievement than more proximal time measures. Increases in time also showed diminishing returns, but the nature of the curvilinear relation between time and achievement is as yet unspecified. Disagreement existed among scholars over whether the size of the effect warrants increases in allocated time, as opposed to other types of interventions. Also, related research indicated that the greater amount of allocated time given to Chapter 1 students may not represent a net advantage. Instead it may serve to lessen an advantage that more able students possess because they generally spend more time engaged in appropriate tasks.

Finally, the literature on both topics contains numerous cautions suggesting that reductions in class size and increases in time cannot be depended upon to produce positive effects in all circumstances. For these interventions to be effective (a)

teachers must be adaptable and have the skills and motivation to capitalize on them, (b) the material taught and tested must fit together, and (c) the strategy for accomplishing the reduced student-instructor ratio must not create as many barriers to learning as it breaks down.

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